EMFAC Modeling Change Technical Memo

SUBJECT: REVISED PLANNING TEMPERATURE PROFILES

LEAD: DILIP PATEL

SUMMARY

The EMFAC model contains daily ambient temperature profiles for use in evaluating evaporative emissions and other heating/cooling related processes. The model has annual average daily temperature profiles for each county or geographical area in the State. The model also has month-by-month average daily temperatures, and two planning profiles: one marked "summer" and one marked "winter". These two profiles are used as worst-case scenarios in planning exercises. The "summer planning" profile is actually the profile for a day in which high ambient ozone concentrations are noted. This is normally during hot weather or the summer season.

Temperature data for the years 1996-2004 was gathered for ozone episodes in the AIRS, NCDC, and RAWS databases. 18 candidate days for each station were chosen with ozone values around the Federal 8-hour design value. Only days with locally-based ozone episodes (multiple local stations exceeding) were included. The profiles were extended spatially on a 4-km grid by interpolation. The resulting profile for each geographical area or county was determined by weighting the temperature on each grid with the VMT for that grid.

In general the high ozone day temperatures proposed are higher than the previous temperature profiles by 5 to 15°F.

A summary of the results for various areas in the State is shown in Tables 1 and 2 below for the years 2002 and 2015. The revised temperature profiles are estimated to increase the planning day emissions from on-road motor vehicles by 60 tons per day (tpd) or 5.3% statewide for HC, 368 tpd or 3.6% for CO, 17,450 tpd or 3.3% for CO_2, and decrease the statewide NOx inventory by 74 tpd (or 4%) in calendar year 2002.

Table 1
Summary of Emissions Changes due to Revised Planning Temperature Profiles
Planning day, Calendar Year 2002

Air Basin	Emission Changes by Pollutant, tons per day				
	ROG	CO	NOx	CO_2	PM
Statewide	60.5	368	-73.8	17,446	0.0
South Coast	7.2	49	-11.1	3,073	0.0
San Joaquin Valley	9.9	83	-15.0	2,080	0.0
Sacramento Valley	7.8	64	-6.3	1,643	0.0
San Diego	1.3	9	-4.0	917	0.0
San Francisco Bay Area	15.7	110	-17.9	5,118	0.0

Table 2
Summary of Emissions Changes due to Revised Planning Temperature Profiles
Planning day, Calendar Year 2015

Air Basin	Emission Changes by Pollutant, tons per day				
	ROG	CO	NOx	CO_2	PM
Statewide	39.8	138	-32.0	23,783	0.00
South Coast	4.4	16	-4.3	3,572	0.00
San Joaquin Valley	7.1	32	-6.9	3,365	0.00
Sacramento Valley	5.8	26	-2.8	2,630	0.00
San Diego	1.1	3	-1.7	1,190	0.00
San Francisco Bay Area	10.3	35	-6.6	6,731	0.00

NEED FOR REVISION

The episodic temperature profiles presently in the EMFAC model were created by taking hourly temperature observations on high ozone days at various recording stations throughout California. These observations were spatially distributed by ZIP code and weighted by population.

The resulting weighted profiles seemed rather cool, because evidently most of the travel occurred in cooler, temperate areas.

This project was initiated to produce more representative or reasonable weighted temperature profiles.

AFFECTED SOURCE CODE/VERSION

TempAssign.for (3/22/2001). Module TEMP_DATA.
The affected lines of Subroutine TEMP_INIT are shown in Attachment A.

METHODOLOGY FOR REVISION

The sources of the meteorological data were the U.S. EPA Aerometric Information Retrieval System (AIRS), the National Climatic Data Center (NCDC), and Desert Research Institute's Remote Automated Weather Stations (RAWS).

For each station 18 candidate days were chosen, grouped around a particular target ozone concentration. This value was the 8-hour Federal ozone design value for each locale.

The candidate days had to be those where there were multiple local stations experiencing high ozone. This is indicative of a local episode, rather than a transport episode.

The profiles were extended to a 4-km grid system by spatial and temporal interpolation.

County or geographic area results were done by weighting the 4-km grid values by VMT in each grid.

In Table 3 is shown the increase of temperature of the new planning temperature profiles for each of the geographical areas used in the EMFAC model. The peak temperatures of the new profiles are also shown.

Table 3
Changes in Temperature Profiles

GAI	Air Basin	County	Increase °F	Peak °F
1	GBV	Alpine	12	80
2	GBV	Inyo	16	91
3	GBV	Mono	10	80
4	LC	Lake	16	90
5	LT	El Dorado	-4	80
6	LT	Placer	-8	80
7	MC	Amador	11	96
8	MC	Calaveras	12	95
9	MC	El Dorado	12	92
10	MC	Mariposa	5	86
11	MC	Nevada	10	90
12	MC	Placer	5	90
13	MC	Plumas	14	91
14	MC	Sierra	14	89
15	MC	Tuolumne	8	88
16	NCC	Monterey	18	87
17	NCC	San Benito	15	90
18	NCC	Santa Cruz	15	86
19	NC	Del Norte	11	77
20	NC	Humboldt	9	78
21	NC	Mendocino	11	88
22	NC	Sonoma	9	86
23	NC	Trinity	-3	83
24	NEP	Lassen	5	82
25	NEP	Modoc	6	80
26	NEP	Siskiyou	3	81
27	SV	Butte	6	95
28	SV	Colusa	10	97
29	SV	Glenn	7	96
30	SV	Placer	11	96
31	SV	Sacramento	6	95
32	SV	Shasta	5	96
33	SV	Solano	9	94
34	SV	Sutter	7	97

Table 3 Continued
Changes in Temperature Profiles

GAI	Air Basin	County	Increase °F	Peak °F
35	SV	Tehama	2	92
36	SV	Yolo	12	96
37	SV	Yuba	7	95
38	SD	San Diego	4	85
39	SF	Alameda	10	90
40	SF	Contra Costa	8	91
41	SF	Marin	14	89
42	SF	Napa	11	94
43	SF	San Francisco	12	87
44	SF	San Mateo	11	87
45	SF	Santa Clara	12	90
46	SF	Solano	8	94
47	SF	Sonoma	14	93
48	SJV	Fresno	7	96
49	SJV	Kern	9	97
50	SJV	Kings	10	98
51	SJV	Madera	8	95
52	SJV	Merced	6	93
53	SJV	San Joaquin	9	93
54	SJV	Stanislaus	9	94
55	SJV	Tulare	9	98
56	SCC	San Luis Obispo	11	86
57	SCC	Santa Barbara	9	78
58	SCC	Ventura	11	81
59	SC	Los Angeles	5	83
60	SC	Orange	4	81
61	SC	Riverside	6	93
62	SC	San Bernardino	6	92
63	SS	Imperial	10	105
64	SS	Riverside	13	99
65	MD	Kern	10	96
66	MD	Riverside	20	105
67	MD	Riverside	20	105
68	MD	Los Angeles	19	99
69	MD	San Bernardino	13	96

INVENTORY EFFECTS

The emission changes for the ozone planning day as a result of the revised ambient temperature profiles are shown below in Tables 5 through 9. Scenario years of 2002, 2005, 2010, 2015, and 2020 are shown. The areas shown are Statewide overall, Sacramento Valley Air Basin, San Diego County, San Francisco Bay Air Basin, San Joaquin Valley Air Basin, and South Coast Air Basin.

Table 5
Summary of Emissions Changes due to Revised Planning Temperature Profiles
Planning day, Calendar Year 2002

Air Basin	Emission Changes by Pollutant, tons per day				
	ROG	CO	NOx	CO_2	PM
Statewide	60.5	368	-73.8	17,446	0.0
South Coast	7.2	49	-11.1	3,073	0.0
San Joaquin Valley	9.9	83	-15.0	2,080	0.0
Sacramento Valley	7.8	64	-6.3	1,643	0.0
San Diego	1.3	9	-4.0	917	0.0
San Francisco Bay Area	15.7	110	-17.9	5,118	0.0

Table 6
Summary of Emissions Changes due to Revised Planning Temperature Profiles
Planning day, Calendar Year 2005

Air Basin	Emission Changes by Pollutant, tons per day				
	ROG	CO	NOx	CO_2	PM
Statewide	62.3	287	-64.6	18,644	0.00
South Coast	7.3	34	-8.7	3,043	0.00
San Joaquin Valley	11.3	68	-14.3	2,337	0.00
Sacramento Valley	9.3	54	-5.9	1,900	0.00
San Diego	2.4	34	-6.9	179	0.00
San Francisco Bay Area	17.6	82	-14.4	5,465	0.00

Table 7
Summary of Emissions Changes due to Revised Planning Temperature Profiles
Planning day, Calendar Year 2010

Air Basin	Emission Changes by Pollutant, tons per day				
	ROG	CO	NOx	CO_2	PM
Statewide	50.4	200	-47.9	21,272	0.00
South Coast	5.6	23	-6.5	3,369	0.00
San Joaquin Valley	9.5	49	-10.6	2,881	0.00
Sacramento Valley	7.6	38	-4.2	2,226	0.00
San Diego	5.8	26	-2.8	2,630	0.00
San Francisco Bay Area	13.6	53	-10.0	6,095	0.00

Table 8
Summary of Emissions Changes due to Revised Planning Temperature Profiles
Planning day, Calendar Year 2015

Air Basin	Emission Changes by Pollutant, tons per day				
	ROG	CO	NOx	CO_2	PM
Statewide	39.8	138	-32.0	23,783	0.00
South Coast	4.4	16	-4.3	3,572	0.00
San Joaquin Valley	7.1	32	-6.9	3,365	0.00
Sacramento Valley	5.8	26	-2.8	2,630	0.00
San Diego	1.1	3	-1.7	1,190	0.00
San Francisco Bay Area	10.3	35	-6.6	6,731	0.00

Table 9
Summary of Emissions Changes due to Revised Planning Temperature Profiles
Planning day, Calendar Year 2020

Air Basin	Emission Changes by Pollutant, tons per day				
	ROG	CO	NOx	CO_2	PM
Statewide	32.2	101	-21.5	25,998	0.00
South Coast	3.6	12	-2.9	3,789	0.00
San Joaquin Valley	5.5	22	-4.4	3,791	0.00
Sacramento Valley	4.5	18	-1.8	2,916	0.00
San Diego	0.9	3	-1.2	1,281	0.00
San Francisco Bay Area	8.0	25	-4.5	7,243	0.00

The change to higher ambient temperature profiles for the ozone planning scenario resulted in an increase in ROG emissions. This is probably due to increased diurnal evaporative emissions from gasoline-fueled vehicles. The increase is about 5% in 2002, rising to 7.5% in 2020. This trend with time is largely the effect of the total emissions dropping due to the prevalence of low-emissions technology. The San Francisco Bay Air Basin shows a higher effect than the South Coast Air Basin because the proposed temperature profile increase is higher in San Francisco.

Due to the higher planning temperature profiles, the CO_2 estimates for the planning day are higher. This is probably due to mileage decrease because of higher air conditioner usage. The magnitude of the increase is 3.3% in 2002 to 3.9% in 2020.

The warmer temperature profiles result in lower NOx estimates for the planning days. The magnitude is 4% decrease in 2002, falling to 3.5% decrease in 2020. The decrease in NOx with ambient temperature increase is an empirical phenomenon for temperatures above about 80°F. Below 80, NOx emissions are seen to rise with increasing temperature.